

A Comparative Study on the Role of National Technology Transfer

Centers in Different Chinese Universities

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1. Introduction

Since the “Bayh-Dole Act” took effect in 1980, many US universities have set up technology transfer offices amounted from 25 to over 200 up till now (Jensen, Thursby, 2003). While in Chinese universities, in line with the government’s policy toward accelerating university S&T findings commercialization, many S&T achievements commercialization offices (STACO) were established in the late of 1990s. Only a very few of them were built in 1980s. The office is in charge of transferring university technology to industry. In 2001, the Ministry of Education and the former State Economic and Trade Commission authorized 6 universities to establish NTTCs. The 6 universities are the followings: Tsinghua University, Shanghai Jiaotong University, China East Polytechnic University, Huazhong S&T University, Xi’an Jiaotong University and Sichuan University.

Why were these 6 universities chosen? Are they Chinese 6 top universities? When we check the statistics on commercialization of S&T findings, the result makes us surprised. China East Polytechnic University and Sichuan University had never been placed in the top 10 universities according to accumulated patents and technology transfer income from 2001 to 2005. While some other universities without NTTCs, like Zhejiang University and Wuhan University, they surely belong to the leading 10 universities, but they have no NTTCs. Zhejiang University even went ahead of Tsinghua University in 2005 with regard to the number of patents and its technology transfer income was more than other 5 universities except Tsinghua. Do NTTCs lose their role? Why can some universities without NTTCs get more technology transfer achievements than those with NTTCs? The answers will be found in the paper. This paper focuses on the role of NTTCs in 6 universities. It includes four sections. The first section gives a brief introduction of NTTCs, like the reasons why NTTCs was set up in universities and their general role. The second one introduces the methodology of the study. Interviews, telephone contacts and questionnaires are put into use. The third part compares the role of NTTCs in different Chinese universities. It is the key section and four hypotheses are used to make the comparative study. The last part draws a conclusion.

2. Background of NTTCs

The establishment of NTTCs is in line with the government’s policies implemented in

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1990s. They are “S&T advancement law of the People’s Republic of China” in 1993, “promoting S&T findings conversion law of the People’s Republic of China” in 1996 and “ the regulations on accelerating S&T findings conversion” in 1999. The government hopes that the operation of NTTCs can strengthen university-industry linkage and commercialize university S&T achievements efficiently.

General role of NTTCs

- Make joint R&D on general technology between university and industry.
- Promote the construction of firm technology center by taking use of university S&T advantages.
- Accelerate the commercialization of university S&T achievements and diffuse them.
- Act as a mediate to strengthen international technology cooperation between domestic firms and foreign firms.
- Provide various required services to firms.

The role of NTTCs is quite similar as that of university S&T achievements commercialization office (STACO). The key difference between them is that NTTCs welcome international technology cooperation. As the government wants to test the role of NTTCs, it does not require university to remove STACO. Therefore, STACO and NTTCs coexist in 6 universities. After a few year performances, NTTCs fulfill more or less the role mentioned above. The comparative analysis will be done in the third section.

Why were NTTCs located in the above 6 universities?

1. Regional disequilibrium

If we pay attention to the locations of 6 NTTCs, it is easy to find out that they are diffused in the East, the North, the Middle and the West of China. As we all know, the East is better developed than the other regions of China. Most top 10 universities are integrated in the East. If all NTTCs were set up in the East, the gap would be further widened. The government hopes the establishment of NTTCs in the West and the Middle will help to shorten the economic development imbalance among regions. Sichuan University and Xi’an Jiaotong University have benefited from the government’s strategy “develop the west”. NTTCs essentially serve local firms, some NTTCs also transfer technology outside local region. But unfortunately, the government neglects technology transfer is usually easier in well-developed regions. Because firms in rich regions tend to adapt new technology, especially in the coastal regions that hold private firms cluster. Private firms often have more incentive to receive high-new technology than public firms. Rich regions also have abundant S&T human resources to absorb the transferred technology. The weakness makes NTTCs inherently deficient.

2. The early birds get worms

All these 6 universities with NTTCs are ranked in China’s top 100 universities. But they are not all positioned in top 6 universities, like China East Polytechnic University and Sichuan University, with regard to the number of granted patents, the amount of technology transfer income and other criteria. In fact, China East Polytechnic University

was the first one who built a high-tech technology transfer center in 1987 among all Chinese universities. Therefore, being an initiative university of TTC, it is naturally accredited to build a NTTC.

3. University leader's attitude toward NTTCs

Some university leaders do not recognize the importance of NTTCs. Their passive attitude guides them not to take active measures to compete for the establishment of NTTCs. In their opinion, a NTTC is nothing different from university S&T achievements commercialization office (STACO). The NTTC is just renamed on the basis of STACO. The inactive attitude causes NTTC to be out of Zhejiang University.

4. Industry policy

The initial fund of NTTCs comes principally from the former State Economic & Trade Commission. The commission manages many national key industries. University's specialty was put into consideration when the Commission chose the locations of NTTCs. For example, Sichuan University specializes in medical science; Xi'an Jiaotong University in electronics, engineering and machinery; China East Polytechnic University in chemical engineering, Huazhong S&T University in machinery manufacturing and electronics, Shanghai Jiaotong University in new material, electronic information, environmental engineering, machinery and biotechnology, while Tsinghua University in science, engineering and liberal art.

Another strange thing is that 2 NTTCs integrate into Shanghai Jiaotong University and China East Polytechnic University respectively. The later is not classified as one of the China's top 6 universities. Why does it hold a NTTC? The doubt is eliminated quickly if we look at the history of this university. China East Polytechnic University is the most famous Chinese university in chemical engineering. It merged 5 universities' chemical engineering departments in 1952. The combination strengthens its research power in chemical engineering field. Meanwhile, the petrochemical industry is attributed to national key industry. The government hopes that Chinese petrochemical industry will improve their capacity of technology innovation with the help of NTTC. Another reason comes from university's experiences in technology transfer. China East Polytechnic University has started to make technology transfer performance since 1987. Most universities do the same thing from the late of 1990s. Besides, its university leaders have foreseen the importance of NTTC. When the Ministry of Education and the former State Economic & Trade Commission reveal their intention to create NTTCs in universities, they are active to apply for the location of NTTC in their university.

3 Methodology of Analysis

As it is hard to collect data on the role of NTTCs in Chinese universities, I use interviews, telephone and questionnaires to contact with people working in NTTCs and S&T division of universities. I had interviews with a director in Tsinghua NTTC and a researcher of Tsinghua University in August. Before the summer vacation came, I sent 45 questionnaires respectively to these 6 universities with NTTCs including other

universities without NTTCs. Because of the vacation, I got only feedbacks from 2 NTTCs (Sichuan NTTC and Huazhong NTTC) and other 6 universities without NTTCs. Hence, I telephoned the directors of NTTCs in China East Polytechnic University, Xi'an Jiaotong University and Shanghai Jiaotong University. At the same time, I contacted with the director of S&T division in Zhejiang University. When I asked them whether they had received the questionnaire, they said they had not got it. The delay probably results from the summer vacation. I sent the questionnaire one and a half months ago. Maybe their summer vacation began earlier than our university. And they just come back to office and have not checked the mailbox. Even though the replies from other universities without NTTCs do not reach me yet, I have got the feedback from all NTTCs.

It seems that telephone contact and interview methods are more efficient than questionnaire. Even though I attached my university's certificate, my business visit card and an envelope with a stamp, the feedback is not satisfying. I hope that I could get more feedback after the new entrance of students to university, namely at the end of September or at the beginning of October. Because university staffs are always quite busy at the beginning of new entrance of students. After that, they often will have less work.

In general, I got all feedback from NTTC staffs in 6 universities. Two interviews with Tsinghua NTTC director, 3 telephone contacts with NTTC director in China East Polytechnic University, 1 questionnaire feedback and 2 telephone contacts with NTTC director in Sichuan University, 1 questionnaire feedback and 2 telephone contacts with NTTC in Huazhong S&T University, 1 telephone contact with NTTC staff in Shanghai Jiaotong University and 3 telephone contacts with NTTC director in Xi'an Jiaotong University. As I put Zhejiang University as an example to compare with 6 universities with NTTCs, I telephoned its director of S&T division twice. Although I haven't received feedback from other universities, it does not impede me to accomplish the paper. On the basis of collected feedback, I use a deductive and qualitative method to finish this paper.

4. The role of NTTCs in Different Universities

"On most university campuses, TTOs mediate the interface between university and industry, through procedures and work practices designed to enact university IP and technology transfer policies."

Owen-Smith, Powell, 2001a

"All technology transfer offices (TTOs) are charged with facilitating and managing the disclosure and licensing of inventions with commercial potential."

Richard A. Jensen, Jerry G. Thursby, Marie G. Thursby, 2003

"Technology transfer offices (TTOs) facilitate technology diffusion through the licensing to industry of inventions or intellectual property resulting from university research."

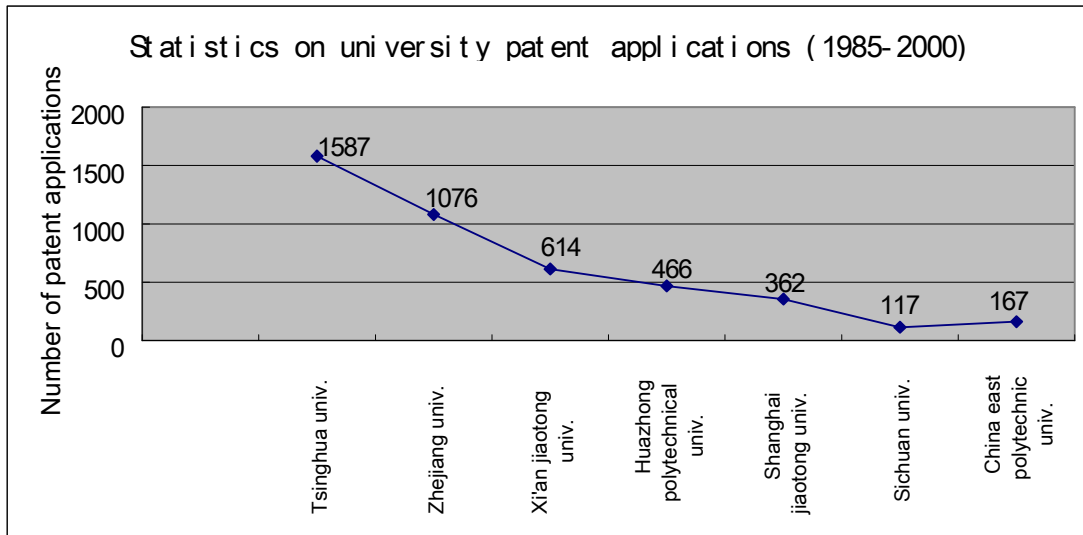
Donald S. Siegel, David Waldman, Albert Link, 2003

Compared with the role of TTOs in American universities, Chinese NTTCs play the similar role. In UK and USA, TTOs personnel must typically devote substantial effort to encourage faculty members to disclose inventions (Siegel et al, 2003b; Thursby and Kemp, 2002, G. Thursby and C.Thursby 2002). In Chinese universities, NTTCs staffs do not spend much time in disclosing university staff's inventions. University staffs are usually voluntary to disclose their S&T findings. This point is critical for increased university patent applications and technology transfer. In fact, university and government incentive policies encourage professor's willingness of invention disclosure. Many universities partially or fully undertake the charges of patent applications and maintenance within 3 years. NTTCs are non-for-profit organizations. Furthermore, inventors receive various material rewards from university and government. Sometimes, position promotion accompanies the reward. Therefore, inventors not only get material compensation but also gain academic reputation. The actual benefit stimulates university staffs to disclose their inventions.

Do NTTCs play the same role in 6 universities? According to our research, we find that the effect of NTTCs appears different. Some NTTCs perform better than others. Tsinghua NTTC is the best one, compared with other 5 NTTCs. One director I contacted told me that the success of Tsinghua NTTC depends on its strong finance capacity. For other NTTCs, finance is a bottleneck. The initial investment from government is only around 1 million RMB and they seldom receive fund after the establishment of NTTCs. University has no long-term strategy to support NTTCs. In fact, several factors impact on the effect of NTTCs, such as university's research capacity, the structure of NTTCs, employed staff's working capability, university incentive policies and so on. We would like to explain it through the 4 following hypothesis.

Hypothesis 1: All of these 6 universities were ranked in China's top six ones with regard to S&T findings and technology transfer income before the establishment of NTTCs in them.

Figure 1
Compare the Number of Patent Applications in Different Chinese Universities
(1985-2000)

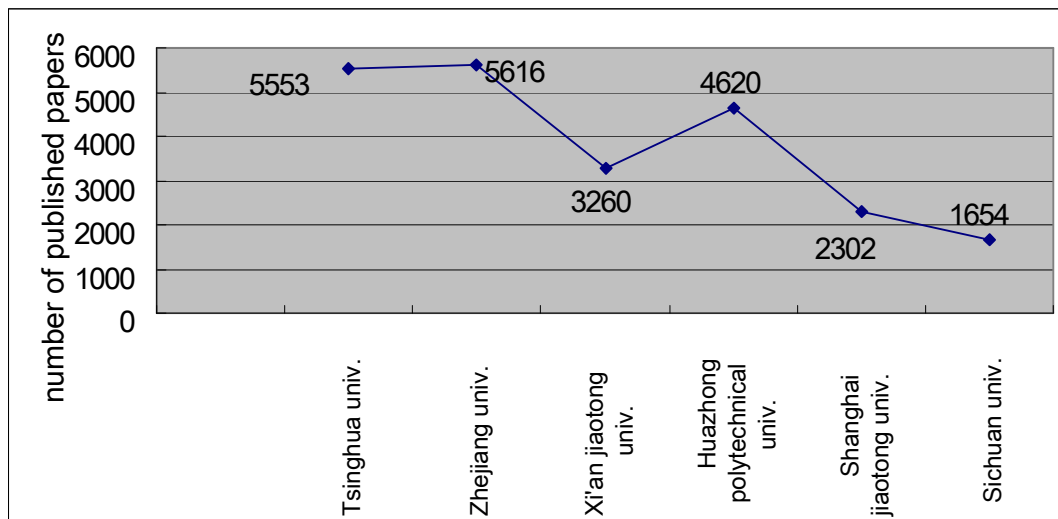


Source: data collected from S&T Development Center of Education Ministry.

Figure 1 highlights that Zhejiang University went far ahead of other 5 universities with respect to the number of patent applications. It had almost 10-fold than that of Sichuan University from 1985-2000. However, it has no NTTC. If we check the rank on the basis of university comprehensive strength, Sichuan University and China East Polytechnic University do not even take the 10th place among all the Chinese universities before the foundation of NTTCs. And Zhejiang University holds around 3rd place.

If we calculate the number of published papers at home and abroad in 2000, Zhejiang University ranked the first place, Tsinghua University 2nd place, Shanghai Jiaotong University 10th, Sichuan University 17th and China East Polytechnic University even beyond 25th. Figure 2 shows the divergence.

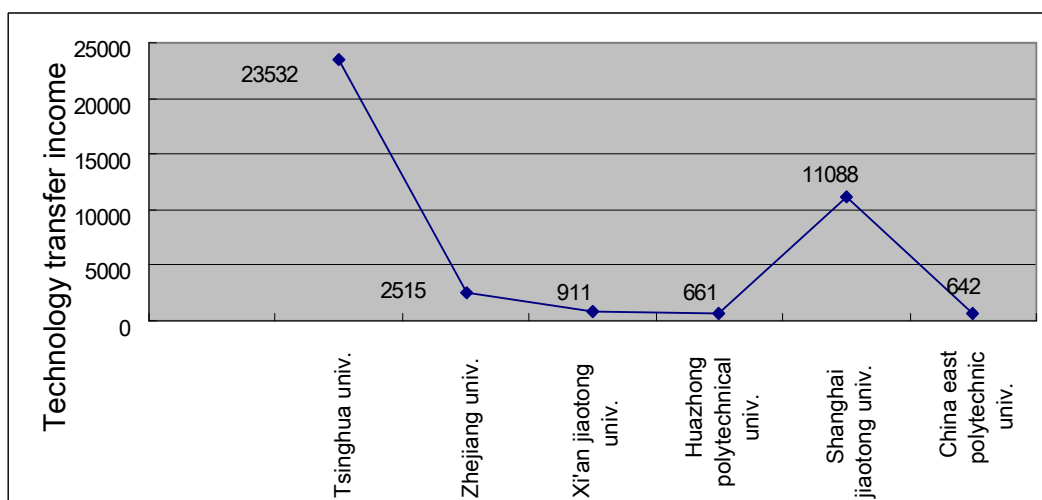
Figure 2.
A comparison on the Number of Academic Papers Published at Home and Abroad
(2000)



Source: data collected from S&T Development Center of Education Ministry.

Another evidence comes from the technology transfer income. Only Tsinghua University and Shanghai Jiaotong University were positioned in the first and third place respectively, the other four universities took the place beyond 10th. And Sichuan University even went away from 25th (see figure 3).

Figure 3
University Technology Transfer Income in 2000, Money Unit: 10 000RMB



Source: data collected from S&T Development Center of Education Ministry.

Figure 3 discloses something interesting. Although Zhejiang University has more than two-fold published academic papers than Shanghai Jiaotong University in 2000, its technology transfer income is much lower than the later. The director of Zhejiang

University explained the reason:

“At the beginning, university undertake neither full patent application fee nor the 3 year’s patent maintenance fee for inventors. Without university incentive policy, inventors are very reluctant to participate in technology transfer process.”

Nevertheless, its capacity of technology transfer is better than other Xi’an Jiaotong University, Huazhong S&T University as well as China East Polytechnic University. Because these 3 universities also face the same problem before the establishment of NTTCs. Hence, university incentive policy is important to technology transfer performance.

From the above three figures, it is proved that NTTCs have not been necessarily established in all the top six universities. Universities without NTTCs do not mean they have no strong capacity to commercialize S&T findings and they can even go ahead of those universities with NTTCs. Zhejiang University is the case. Hence, hypothesis 1 is refused. The paper has explained the reasons why NTTCs were not set up in all the top 6 Chinese universities in the first section.

Hypothesis 2: All of the 6 universities have facilitated S&T findings commercialization and improved research capacity due to the existence of NTTCs.

Compared their technology transfer income in 2000 and 2001, hypothesis 2 is accepted. But when we look at the patent sales volume in 2001 and 2002 (see figure 4), hypothesis 2 is not fully acceptable. All directors whom I have contacted confirm the positive effect of NTTCs on university technology transfer. Nevertheless, for most NTTCs, their role is partially fulfilled and university technology transfer has only been lightly increased up till now. Speaking objectively, NTTCs play a moderate role in technology transfer from university to industry.

In UK and USA, licensing has traditionally been the most popular mode of university technology transfer (Chapple, Lockett, Siegel, Wright, 2005; Siegel et al, 2003b). In China, the mode of technology transfer is usually done by technology transaction contracts and technology cooperation agreements. Licensing is embedded in technology transaction contracts. In reality, joint technology development is rather popular. Because when university technology is not mature, it is difficult to transfer it by licensing. Technology cooperation agreement is an effective way to reduce risk for firms. As data on technology cooperation agreement is not found, hence, we use the number of patent sales contracts and patent sales volume to analyze the impact of NTTCs on university S&T findings commercialization (see figure 4).

Figure 4.

University Patent Sales Contract Number and Patent Sales Volume (2001-2002), Money Unit: 10 000 RMB				
Name \ Year	2001 three kinds of patents		2002 three kinds of patents	
	number of patent sales contracts	patent sales volume	number of patent sales contracts	patent sales volume
Tsinghua univ.	137	7176	133	6685
Zhejiang univ.	45	2010	74	1028
Shanghai Jiaotong univ.	9	1250	5	423
China East polytechnic univ.	18	900	18	631
Huazhong S&T univ.	7	635	5	557
Xi'an Jiaotong univ.	8	188	9	210
Sichuan univ.	0	0	5	120

Source: data collected from www.cutt.edu.cn/paiming

Figure 4 tells us that NTTCs in some universities do not perform well. Except Xi'an Jiaotong University and Sichuan University, other 4 universities decreased patent sales volume. The number of patent sales contracts in Sichuan University made a historical breakthrough from zero in 2001 to 5 in 2002. Tsinghua University, Shanghai Jiaotong University and Huazhong S&T University all declined both the number of patent sales contracts and patent sales volume. Directors of NTTCs disclosed the reason:

“University technology transfer usually focuses on a minority of S&T achievements. The majority of findings have never been transferred.”

“We are not allowed to become an independent department. All of NTTCs are subordinated to university S&T division. Our performance is lack of flexibility. Furthermore, we control no corporation limited for profit business, except Tsinghua NTTC. Lack of funds influences our operation.”

However, both the number of both patent applications and granted patents has obviously increased (see figure 5).

Figure 5.
The Number of Patent Applications and Grants Number of Sichuan University from Home (2001-2005)

Name \ Year	2001		2002		2003		2004	
	2005							
	A* A.	G* G.	A.	G.	A.	G.	A.	G.
Tsinghua univ.	393 930	163 --	583	164	767	376	762	527
Shanghai jiaotong univ.	198 1093	38 --	377	46	730	156	829	332
Zhejiang univ.	177 1244	69 534	412	91	660	211	875	321
Huazhong S&T univ.	116 --	60	152	60	236	82	221	136 --
China east polytech.univ.	61 --	6	86	21	155	44	150	79 --
Xi'an jiaotong univ.	55 232	35 133	114	35	189	37	183	131
Sichuan univ.	44 237	22 --	139	20	182	57	203	111

Source: calculated by the author based on data from S&T development center of Ministry of Education

A*: represents the number of patent application

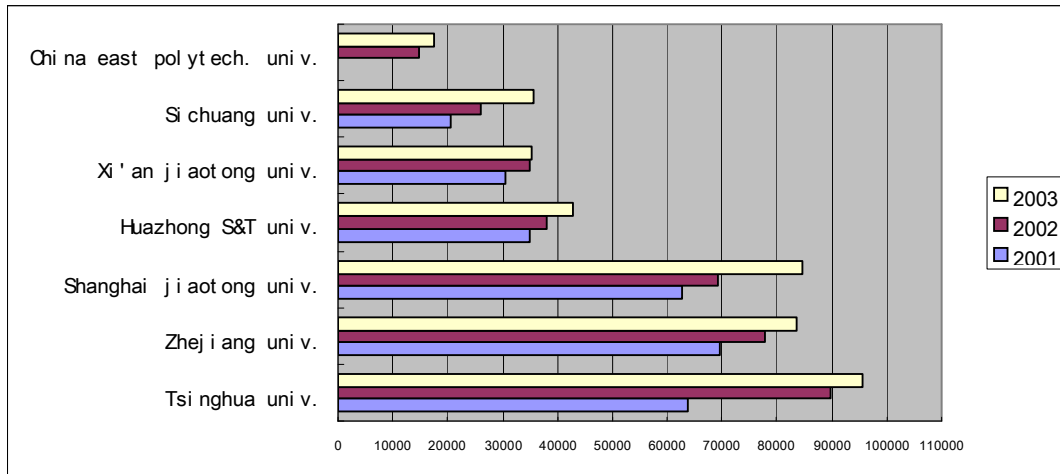
G*: represents the number of granted patents

From figure 5, we can see from 2001 to 2002 the number of patent applications and granted patents grew rather slowly. But, from 2002, almost all the six universities with NTTCs doubled the number of patents. Tsinghua took the first position with respect to accumulated granted patents from 2001 to 2004, and Zhejiang University held 2nd place. Due to increased patents, Sichuan University advanced its rank from 11th to 9th among all the Chinese universities.

Have NTTCs promoted the growth of university patents? According to the opinion of NTTCs officers, NTTCs do contribute to the increasing number of patents, but its role is rather weak. NTTCs help university inventors to apply for patents. Many universities owned a patent office in order to provide convenient service to inventors. But now, the patent office separates from university and becomes an independent S&T intermediary. Universities do not take management risk for it any more. These patent offices are usually located near or in university campus. Inventors either go to the patent office or demand for NTTCs' help to process patent application. Many NTTCs hold intellectual property office. When inventors meet intellectual property problems, they can consult with IPO. The services of NTTCs is free of charge for university staffs. Some other elements are found to support the growth, such as the increasing R&D expenditure (see figure 6) and

university incentive policies. For instance, Sichuan University merged Chengdu S&T University in 1994 and Huaxi Medical University in 2000. After that, its research capacity becomes stronger in material, energy, engineering and medical science. R&D expenditure increased sharply from 0.2 billion RMB in 2001 to 0.7 billion RMB in 2005. The continuous growth of investment leads to rich output: more research papers published at home and abroad, more patents and technology transfer deals.

Figure 6.
University R&D expenditure 2001–2003, Money Unit: 10 000RMB



Source: data collected from www.cutt.edu.cn

In addition, public and private organizations disclose the ranks of Chinese top 100 universities. The number of patents and technology transfer income is one of the important evaluative criteria. Since the entrance to university has becoming much easier and registration fee has increased heavily, students prefer to choose universities with good reputation in teaching and research. Furthermore, the government reduces patent application fee, maintenance fee as well as various rewards to encourage university technology transfer. In line with internal and external requirement, universities have increased investment in R&D. Besides, it provides some incentive policies to researchers. Inventors not only get direct material reward from university but also gain more possibility to be promoted in position. Some universities even take all the charges of patents (patent application fee and three years' maintenance fee) together with local government.

Hypothesis 3: Universities weakened their capacity to commercialize S&T findings because of having no NTTCs.

This hypothesis is denied when we take Zhejiang University as a case study. IT has no NTTC, while its patents have largely increased in the recent years. Except its inherent strong research capacity and continuously increased R&D expenditure, another important reason is that university together with local government undertakes patent application fee and 3 year's patent maintenance fee. Researchers disclose S&T findings, and then NTTC

staffs are responsible for the whole process of patent application. Moreover, its patent sales contract number hits 45 in 2001 with the 2nd rank and jumped to 74 in 2002, keeping the same place just behind Tsinghua University. The progress attributes to the existence of S&T achievements commercialization office (STACO), belonging to S&T division. The office keeps close contacts with firms and local government, especially local key firms. The government provides special fund to support technology transfer. Thanks to abundant S&T findings, 3 affiliated technology transfer centers have been set up in Zhejiang province and 6 in other provinces. These 9 centers are subordinated to STACO. Besides, STACO has explicit labor division and only 6 staffs work for it. The source of staffs is diversified: professors, graduates, doctors, retired professors and outsourced experts. The different background of TTC staffs makes the work team dynamic.

Why do some universities with NTTCs lag behind other universities without NTTCs with respect to technology transfer?

On the basis of telephone contacts with directors working in universities without NTTCs, the answer is found that their universities have S&T achievements commercialization offices (STACOs) who perform the similar functions as NTTCs. STACOs help inventors to apply for patents, evaluates the market value of patents, then contacts with firms to commercialize the technology. Universities with NTTCs do not have independent staffs. NTTCs and STACOs both belong to university S&T division. STACO staffs work for NTTC and STACO. Therefore, we call this phenomenon “a wagon with two horses”. Here wagon means the same staffs, while two horses refer to NTTC and STACO respectively.

Due to no clear labor division between NTTCs and STACOs and incentive policies only benefiting university and inventors, staffs are lack of work enthusiasm. No matter how much technology is transferred, there is nothing changed with their position and salary. The higher efficiency of technology transfer only benefits university and inventors. It seems stupid to do more work without any compensation. Furthermore, at the initiative of NTTCs, the Ministry of Education and former State Economic and Trade invested around 1 million RMB. In the course of performance of NTTCs, some local governments realize NTTCs will contribute to the development of local economy. Therefore, they finance NTTCs through research projects. Some universities give very limited funds to NTTCs. It cannot meet the requirement of NTTCs at all. Meanwhile, the Ministry of Education and the former State Economic & Trade Commission do not invest any more to NTTCs. Low work enthusiasm and finance bottleneck leads to low efficiency of NTTCs.

Hypothesis 4: A NTTC has the same effect on each university.

The hypothesis is not supported when we go over figure 4 and figure 5. The impact of NTTCs is determined by several factors, such as the organization of NTTCs, the performance mode of NTTCs, university research capacity, university-industry linkage and the location of university. This paper focuses on explaining the reason why Tsinghua NTTC works better than other NTTCs. Let's look at figure 7 first in page 14.

Foundation year: Tsinghua NTTC is the earliest one to make technology transfer performance. Most NTTCs began to operate in the late 1990s, while Tsinghua NTTC started in 1983. Its longer history helps it accumulate more experiences than other NTTCs. The existence time of TTO influences its efficiency (Owen-Smith, Powell, 2001a). Rich experiences in technology transfer contributes to fulfilling Tsinghua NTTC's role.

Staff source: Tsinghua NTTC is the unique one, which employs full-time business professionals, and it has a larger work team. Other NTTCs staffs are mainly composed of engineers and the number of staffs is less than 10. Lack of skilled business talents hampers their performance. Some foreign economists have pointed out that TTOs operate with low efficiency because their staffs are lack of requisite business skills and experts (Siegel, Waldman, Link, 2003; Owen-Smith, Walter, Powell, 2003). Like other NTTCs, Tsinghua NTTC staffs partially come from its attributive university, and some are outsourced. Tsinghua Economic and Management Faculty is the best one in China. It has trained many excellent managers. Thanks to Tsinghua famous reputation, it is easier for the NTTC to employ outstanding business talents from campus and outside campus. From this viewpoint, Tsinghua staffs are better adept at marketing and law.

Recent fund source: Unlike other NTTCs, Tsinghua NTTC has a finance advantage. The funds come from Beijing government, university and its own corporations limited. Sufficient funds improve the welfare of NTTC staffs. Staffs are stimulated to work hard. NTTC even invests in academic start-ups. Directors of NTTCs in Huazhong University and Sichuan University told me that they have no financial support from university, government and firms after the foundation of NTTCs. Many business trips have to be cancelled due to finance problem. They get no incentive to work. Finance is a bottleneck for other NTTCs.

U-I relation: University-industry linkage in Tsinghua is much closer, compared with other universities. The structure of Tsinghua NTTC promotes the relation (see figure 10). Due to the intimacy contacts with industry, Tsinghua knows what firms want and firms know what Tsinghua has. Combining the university's S&T advantage with firm's finance advantage, technology is easier to be transferred from university to industry. On the contrary, such a linkage is rather loose in Huazhong S&T University. Its director of NTTC explains to me that they have no enough budget to be out of office and just wait for the firms to come to them. Xi'an Jiaotong NTTC seems not to be perplexed by finance problem. It invests money in university lab findings, makes experiments, and then commercializes the findings. Since industry involves in the last stage of commercialization, university-industry linkage is overleaped at the former stages.

In reality, NTTCs usually use the following modes to contact with industry:

- ♣ website: university S&T findings are listed on S&T division website, patent website and national high-tech findings transaction website. It is free of charge to login in the websites. If firms are interested in the findings, they can easily find

the methods to contact with NTTCs. Because how to reach NTTCs staffs has been noted in the websites, such as names of NTTCs staffs, fax number and telephone number, electronic mail address and postal address.

- ♠ High-tech exhibitions: NTTCs staffs often participate regularly in university S&T achievements exhibitions. Through the exhibitions, NTTCs present new technology to the public and meet firms who are interested in their technology.
- ♠ University-industry club: this club acts as a bridge between university and industry. NTTCs meet firms and discuss technology issues with them regularly. If firms have technological problems or want to do R&D with universities, they come to the club and tell NTTCs what they want. NTTCs also present the new technology to firms at the club. This channel is formally used in Tsinghua NTTC.
- ♠ Joint R&D project: Firms may propose a research project to NTTCs or NTTCs actively recommend industry a certain kind of technology relative to their R&D project. If the project attracts industry's attention, NTTCs organize university S&T researchers to work jointly with them. University can invest its S&T findings as an input, and then get some part of equity from the firm. Sometimes, university, together with industry, applies for the government's research projects through NTTCs.

Number of affiliates and subordinated corporations limited: Tsinghua NTTC, Shanghai Jiaotong NTTC and China East Polytechnic NTTC have one affiliate respectively in different provinces. The two formers are located in rich regions Guangzhou and Jiangsu, while the later in less developed region Henan. In general, technology is more successfully transferred and diffused in rich regions. Toward subordinated corporation limited, Tsinghua NTTC is the unique one who has 2 corporations limited. These corporations help it import technology from abroad.

Figure 7.
A Comparison on NTTCs in Different Universities

Name	Foundation	Staff source	Superior	Initial fund source	Recent	fund
source	U-I* relationship	N.*of affiliates	N.*of subordinated			
of NTTC	year	/location	corporation limited			
Tsinghua government,	1983	Engineers, strong lawyers, subordinated business talents	Scientific research 1/Guangzhou institute	Ministry of Education 2 SETC*		Local
					university, companies	
Shanghai government Jiaotong Univ.	the late of 1990s	Engineers, strong lawyers	S&Tdevelopment 1/Jiangsu research institute	Ministry of Education No SETC*		Local
					university	
China East University Polytechnic Univ.	1987	Engineers moderate lawyers	S&T division 1/Henan	Ministry of Education No SETC*		
Huazhong S&T Univ.	1999 No investment	Engineers lawyers	S&T division loose	Ministry of Education No SETC*		
Xi'an government Jiaotong Univ.	1999	Engineers ordinary lawyers	S&T division No	Ministry of Education No SETC*		Local
					university	
Sichuan investment Univ.	1999	Engineers ordinary	S&T division No	Ministry of Education No SETC*, local government		No

Source: information above comes from questionnaires, interviews and telephone contacts with directors of NTTCs.

U-I*: refers to university-industry.

N*.: represents number.

SETC*: refers to former State Economics & Trade Commission

Figure 8

. A Comparison on Different Chinese Universities

Name of univ.	Foundation	Type of	N*.of national	N*.of national	N*.of
national engineering graduates	N*.of website	N*.of academicians*	N*.of	N*.of	N*.of
	year/locationuniv.	key subjects	key lab	research center	
	cooperation center		professor	(doctors	
	included)				
Tsinghua univ.	1911/Beijing	C/R/P*	49	26*	5
7	65	1176		10623	
Shanghai jiaotong univ.	1896/Shanghai	C/R/P	22	6	4
1	35	743		18100	
Xi'an jiaotong univ.	1896*/Shaanxi	C/R/P	20	4	1
1	16	680		12735	
China east polyte.univ.	-*	/Shanghai	C/R/P	3	2
No		23*	1000	5550	2
Huazhong S&T univ.	-	/Hubei	C/R/P	15	4
1	16	1025		18884	5
Zhejiang univ.	1897/Zhejiang	C/R/P	24	13	5
1	22	1100		17000	
Sichuan univ.	1896/Sichuan	C/R/P	15	2	3
2	31*	1047		16129	

Source: data collected from each university's website.

N.*: represents number.

Academicians*: include academicians in China Academy of Sciences and China Academy of Engineering.

C/R/P: represents comprehensive, research and public university. All the universities in Figure 7 belong to China top 100 universities.

28*: It includes 12 national key labs and 14 key labs subordinated to the Ministry of Education.

1896*: Shanghai Jiaotong University was the predecessor of Xi'an Jiaotong University. According to the government's strategy "developing the west" in 1956, the main part of Shanghai Jiaotong University moved to Xi'an. In 1959, it was officially renamed Xi'an Jiaotong University.

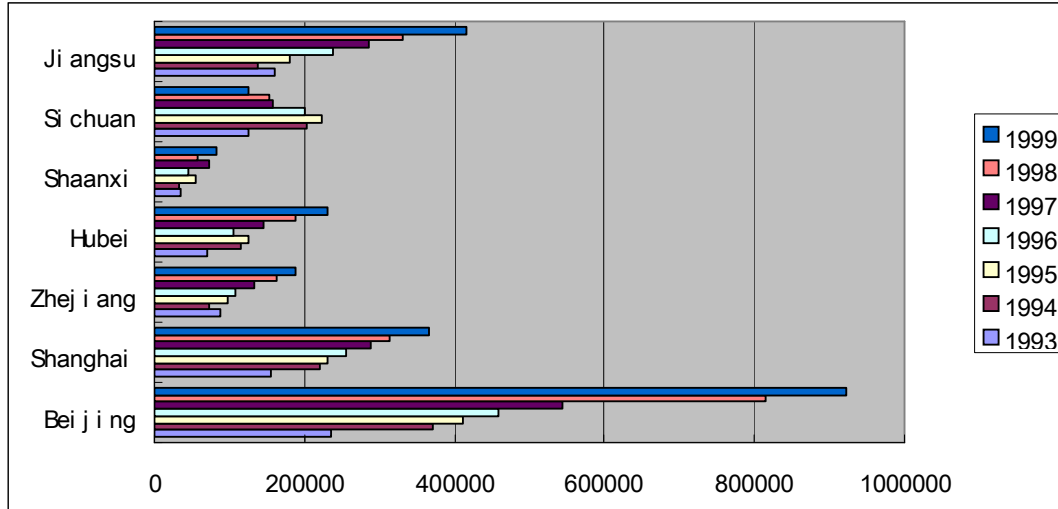
-*: We cannot confirm the exact foundation year only knowing it has a history over 100 years.

23* and 31*: it means that the number of academicians embeds the number of invited academicians.

Figure 8 shows the divergence among universities. All universities with NTTCs have a long history and belong to comprehensive, research-orientation public universities. Tsinghua takes the first place with respect to the number of academicians, national key subjects and labs. Together with the former data on patents, R&D expenditure and published papers, Tsinghua obviously goes ahead of other 5 universities. Because of the inherent disequilibrium before the establishment of NTTCs, how can we emphasize the same effect of NTTCs on each university?

In addition, the locations of NTTCs play an important role, impacting on the operation of NTTCs. If a NTTC is located in a developed region, its effect is larger toward technology transfer. Technology transaction value is relative to region. NTTCs in Beijing and Shanghai run more efficient with regard to technology transfer income than those in Sichuan and Shaanxi. Beijing and Shanghai are rich in S&T human resources, capital and government's support. Firms there have stronger capacity to absorb technology transferred by NTTCs. The better of absorption capacity a region holds, the more dynamic the technical market is there. Even though the west and the middle have kept a fast economic growth in recent years, the divergence still exists among regions. In fact, the gap with respect to technology transaction value has already been appeared before the performance of NTTCs. Figure 9 supports our findings.

Figure 9.
Transaction Value in Technical Market by Region, Money Unit: 10 000 RMB



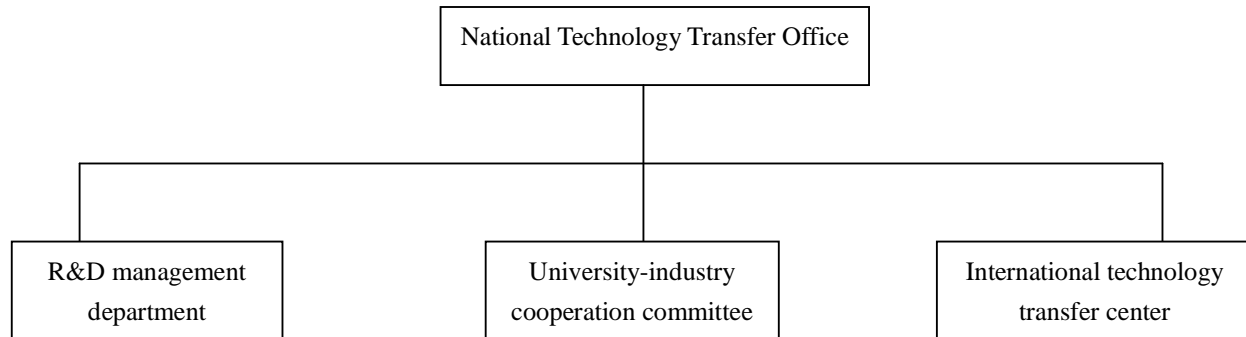
Source: China Statistical Yearbook 2000, page690

5. NTTCs Structure impacts on the role of NTTCs

Tsinghua NTTC has more clear labor division, compared with other NTTCs. Although it is subordinated to Scientific Research Institute (SRI) of Tsinghua University, overlapped work is not common between them. Here SRI acts as S&T division in other universities. Thanks to a comparatively independent work team, its structure holds

special characteristics (see figure 10).

Figure 10.
The Structure of Tsinghua NTTC



The above structure shows that Tsinghua NTTC focuses on technology management and transfer. It is composed of three parts: R&D management department, university-industry cooperation committee and international technology transfer center.

Founded in 1983, R&D management department manages commercial contracts related to technology transfer, to the intellectual property issues, and to the dissemination of research achievements. It also coordinates the cooperation between Tsinghua and regional governments and enterprises. Up till now, it has signed cooperation agreements with two-thirds of provincial administrations and the cooperated fields involve in technology, personnel training, education, and strategic economic planning.

1995 saw the establishment of university-industry cooperation committee. University-industry meetings are held regularly here. 138 domestic and 38 foreign firms, NTTC staffs are club members as well as university researchers. Over 20 foreign members are ranked in world top 50 firms. Firms should pay a sum of registration fee for becoming a club member. The committee provides various services to firms, like business intelligence service, development strategy research, technology diagnosis, consulting on finance & investment, talent training, and information service. These services are not free of charge. The income from services supports the sustainable development of NTTC.

Accredited by the former State Economic & Trade Commission and the Ministry of Education in September 2001, international technology transfer center (ITTC) became a national technology center. Its main task is to introduce internationally advanced and mature technologies to domestic industry. At the same time, it helps domestic firms assimilate overseas technologies and provides services for firm's indigenous innovation. In order to make technology transfer more efficient, ITTC set up two companies. One is called Kewei, responsible for transferring North American and European technology to domestic firms, the other is called Luying, undertaking technology transfer from Russia

to Chinese firms.

In one word, Tsinghua NTTC provides a broad platform for strengthening university-industry relation. 70% of Tsinghua S&T findings have been used in industry and 20% have achieved outstanding success. Each year, Tsinghua together with domestic industry, undertakes nearly 800 projects with a contract value of more than 0.4billion RMB. However, Tsinghua NTTC neglects to improve original innovation capacity of domestic industry. It imports technologies abroad, integrates them with local technology, and then transfer to local firms.

6. Conclusion

On the basis of comparative study on the role NTTCs in different universities, we find that NTTCs do play a role in promoting technology transfer. But their effect is moderate and lower than we expected. The findings in detail are as the followings:

First, there is no explicit labor division between STACOs and NTTCs. Overlapped work and shuffling off duties causes low efficiency. Except Tsinghua, there are no full-time professional business talents working for NTTCs. The majority of staffs are engineers. The existence of intellectual property offices in NTTCs shows that universities have a strong consciousness to protect intellectual property while pay little attention to marketing skills of staffs in NTTCs.

Second, finance bottleneck and no incentive policies blocks work enthusiasm of NTTCs staffs. Some NTTCs staffs have to stay in office waiting for industry because of finance problems. Existed incentive policies only benefit university and inventors, excluding NTTCs staffs.

Third, universities need not to have NTTCs instead of STACOs. STACOs in universities can carry out the same role of NTTCs, like Zhejiang University. And the effect of NTTCs is divergent in universities. It depends largely on several factors, such as university initial S&T capacity, the structure of NTTC, incentive policies, staff quality and so on. Tsinghua NTTC runs better than other NTTCs, because it has a clear labor division, special structure and abundant S&T human resources...

Finally, we should point out that regional development impacts on the performance of NTTCs. NTTCs in the Middle and the West, deal less technology transfer cases than those in the East and the North, especially international technology transfer business. This may results from few foreign investments there. NTTCs in Tsinghua and Shanghai Jiaotong have experienced such an attempt, but they only focus on importing technologies and combine them with local technology, neglecting to develop original technology innovation capacity of domestic industry.

For the future performance of NTTCs, we suggest the labor division between STACO

and NTTC should be explicit. And NTTCs staffs need to be stimulated by university reward policies. For example, university promises that technology transfer income is relative to NTTCs staffs salary and personal position promotion. The value volume of technology transfer is advised to use as one of the criteria to evaluate NTTCs staffs quality. If they successfully transfer more technology, they hold more position promotion possibility and more material reward. Beside, in order to make NTTCs run smoothly, the financial problem of NTTCs should be paid attention. Providing for-profit services to industry seems to be a shortcut.

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